

REQUEST FOR PROPOSALS

CENTRAL CALIFORNIA OZONE STUDY (CCOS)

Design of Central California Aerometric Monitoring Network Enhancements to Fulfill Air Quality Responsibilities

April 29, 2005

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1. BACKGROUND

The Central California Ozone Study (CCOS) is intended to provide another milestone in the understanding of relationships among emissions, transport, and ozone standard exceedances, as well as to facilitate planning for further emission reductions needed to attain state and federal ozone standards. The CCOS is to gather aerometric and emissions databases for modeling and to apply air quality models for the attainment demonstration portion of the SIP for the federal 8-hour and state 1-hour ozone standards. CCOS is an integrated effort that includes air quality and meteorological field measurements, emissions characterization, data analysis and air quality modeling. The modeling domain for CCOS covers all of central California and most of northern California, extending from the Pacific Ocean to east of the Sierra Nevada and from Redding to the Mojave Desert. The selection of this study area reflects the regional nature of the state 1-hour and federal 8-hour ozone exceedances, increasing urbanization of traditionally rural areas, and a need to include all of the major flow features that affect air quality in central California in the modeling domain. The CCOS field measurement program was conducted in the summer of 2000 in conjunction with the California Regional PM₁₀/PM_{2.5} Air Quality Study (CRPAQS), a major study of the origin, nature and extent of excessive levels of fine particles in central California (Watson et al., 1998).

The CCOS is directed by a technical committee that comprises staff from the California Air Resources Board (ARB), U.S. Environmental Protection Agency (EPA), the California Energy Commission (CEC), local air pollution control agencies, industry, and other sponsoring organizations with technical input from a consortium of university researchers. The CCOS plan consisted of a field study plan (Volume I, Fujita et al., 1999) and a field operations plan and protocol (Volume II, Fujita et al., 2000), which were available in April 2000. These documents correspond to the two phases of the planning process for CCOS.

CCOS and CRPAQS are components of the Central California Air Quality Studies (CCAQS). With the completion of the field programs and the submission of data to a centralized data management system for CCAQS (O'Brien, 2001-04, <http://www.arb.ca.gov/airways/Datamaintenance/default.asp>), work is ongoing to improve the data inventory, data analysis capabilities, and quality assurance.

1. MANAGEMENT STRUCTURE

The CCOS is a program involving many sponsors and participants. Three entities are involved in the overall management of the Study. The San Joaquin Valleywide Air Pollution Study Agency, a joint powers agency (JPA) formed by the nine counties in the Valley, directs the fund-raising and contracting aspects of the Study. A Policy Committee comprised of four voting blocks (State, local, and federal government, and the private sector) provides guidance on the Study objectives and funding levels. The Policy Committee approves all proposal

requests, contracts, and reports. A Technical Committee parallels the Policy Committee in membership and provides overall technical guidance on proposal requests, direction and progress of work, contract work statements, and reviews all technical reports produced from the Study.

On a day-to-day basis, the ARB is responsible for management of the Study under the direction of the Program Manager, Chief of the ARB Modeling and Meteorology Branch. The ARB monitors contracts with the participants and is the primary interface between contractors, the Policy and Technical Committees, and the JPA. Members of the Technical Committee are active participants in modeling analyses and in the review of proposals, reports, and publications.

2. SCOPE OF WORK

The Central California Ozone Study (CCOS) Technical Committee has identified the need to supplement the existing ambient and meteorological monitoring network to provide a measurement network that more completely supports the forecasting and modeling requirements for air quality in Central California. The existing statewide ambient monitoring network has been designed to meet federal and state compliance requirements by monitoring at locations expected to experience the highest pollutant concentrations. The existing network fulfills the initial purpose of detecting air quality that fails to meet federal and state standards. However, additional air quality and meteorological data are required to meet the consequent responsibilities to alert the public to impending episodes of poor air quality and to develop predictive models that can evaluate the value of potential corrective actions. The complexities of analysis and prediction require collection of supplemental data at key locations. The principal objectives of this project are: to identify key additional measurements that would enhance the ability to meet the consequent responsibilities, to estimate the cost of providing such additions to the existing network, and to prioritize the relative value of additional types, methods, and locations of measurement.

RFP FOCUS: This RFP requests a proposal from a contractor, independently or in conjunction with other expert consultants, that would evaluate the existing monitoring network, identify gaps in data collection that affect the quality and precision of data analysis, modeling, and forecasting, and identify network improvements that would address these technical limitations. The Technical Committee expects the improvements would result in a network that is equally robust in both chemistry and meteorology measurements. The analysis should identify the types of additional monitors and measurements needed, describe the methodology that should be used for site selection and identify potential candidate locations that would be appropriate for collection of the desired data. The analysis should consider the goals and objectives identified by the Technical Committee and the Technical Committee's initial efforts to review network enhancement, as well as additional factors determined by the contractor to be significant to such analysis. The contractor is also encouraged to follow, to a reasonable extent, the applicable recommendations of the recent National Academy of Science (NAS) report on air quality management even though the Technical Committee does not expect the contractor to design a network fully compatible with the NAS recommendations. The project requires documentation of the factors considered and results of network design review. Products required also include an estimate of costs for implementing and maintaining the network improvements, performing quality assurance and quality control (QA/QC), conducting data analysis and providing data archiving.

BACKGROUND: The following information is provided to provide a better understanding of the nature of the network design requested.

The enhanced ambient network design should, if fully implemented, provide:

- Data for the criteria pollutants ozone and particulate matter, and to an appropriate extent the precursors and associated air toxics to these pollutants
- Surface and aloft meteorological data on a continuous rather than episodic basis
- QA/QC, analysis and archiving of collected data
- A database, or collection of independent databases, that can be used to support and refine analysis of pollutant conditions and trends

Goals: The goals for this network as currently identified by the Technical Committee include:

- **Provide capability to model any adverse air quality event or interval:**
Modeling a single or a small number of episodes has been used as a basis for planning to address the one-hour ozone standard, but is not sufficiently robust as an approach for evaluation of eight hour ozone exceedances or the federal PM_{2.5} annual standard. The nature of exceedances for PM_{2.5} and eight-hour ozone involve longer portions of the year, include different seasons, and subsequently require evaluation of longer periods than can be supported by temporary field studies. The temporary networks that have been established to provide data for short-term episodes have demonstrated the extent of information required to support analysis. The existing ambient network does not provide data collection comparable to the temporary field studies, but the field study networks are too expensive to maintain indefinitely. A program of additional measurements that can be collected on a continuous basis must be identified, to provide the data requisite to create an integrated strategy that will provide the most effective guidance for reductions needed to meet the standards. The network must be enhanced to provide a robust dataset for input to the air quality models to support reliable modeling of entire pollutant seasons, modeling of more episodes in different seasons and evaluation of models to ensure accuracy in simulating the dynamics of observed episodes.
- **Support corroborative data analysis to determine strategy effectiveness:**
Data analysis is a mechanism to provide independent corroboration of modeling results. Data are also needed to determine if the strategy developed through modeling is actually leading to improvements in air quality or if midcourse corrections are needed. The existing permanent network provides data to determine compliance with the standards, but is not sufficient to support the extensive modeling or other corroborative evaluation needed to examine cause-and-effect relationships to verify the performance of implemented strategies. The factors and conditions contributing to California's air quality problems require more extensive data collection than

the existing routine ambient network to support detailed corroborative analysis.

- **Include interpollutant synergism to develop an integrated strategy for air quality management:** Collection of sufficient data for modeling and analysis is critical to development and tracking of an integrated plan for successful air quality improvement. Existing air quality compliance planning has been developed on a pollutant-by-pollutant basis; however, the precursors and formation mechanisms for ozone, particulate matter, and air toxics are linked through chemistry/physics. This linkage includes, but is not limited to, the interrelated nature of the formation mechanisms, gas/particle phase relationships, the effect of limiting precursors, particle formation and sublimation processes, and the chemical and physical partitioning of precursors into different pollutants. Consequently, an integrated assessment and planning process is essential to minimize unintended consequences from implementation of a strategy for one pollutant that might adversely affect efforts to reduce another pollutant.
- **Provide data to support districts, state and federal air quality forecasting, smoke management and fire weather efforts:** The data collection required for real-time forecasting of smoke dispersion conditions is closely related to the network necessary for extensive episode evaluation. Existing network measurements are currently supplemented by forest service and other agency instrumentation; however, the network needs additional enhancement to reduce uncertainties and to provide accurate predictions. Additional data are needed to manage the programmed emissions and provide advisories to the public for adverse air quality caused by unforeseen events or weather changes that result in unexpected adverse impacts from planned events.

Objectives: In order to fulfill the above goals, the CCOS Technical Committee has defined a set of objectives. These objectives are designed to meet both regulatory and scientific/technical needs to continue to improve the accuracy, insightfulness and reliability of evaluations and projections of air quality. The objectives also may help define the types of measurements and analyses needed to provide the relevant information.

- **Surface and aloft meteorology:** All of the goals require much more robust collection of surface and aloft winds, temperature, and humidity measurements. The current routine network is sparse in terms of providing sufficient data for analysis of dynamics and evaluation of prognostic modeling performance (required to support all goals).
- **Routine air quality modeling:** It is not possible at the present to set up and simulate an episode that has recently occurred, yet having the ability to do so would enhance the understanding of ozone formation for the specific episode and whether strategies developed for the SIP would be effective. The

envisioned monitoring network, along with near real time access to it, would allow this type of modeling (element of first goal).

- Transport assessment: Present assessments are dependent on surface meteorological and ozone measurements. These methods identify transport pathways, but cannot describe the related air chemistry needed to improve mitigation measures or the three-dimensional aspect of transport (element of first goal).
- Trends for ozone, particulate matter and air toxics, and their precursors: Long term monitoring is needed to determine if there is a trend, and to be able to quantify the trend. While the present network can be used to track criteria pollutants, tracking of precursors is inadequate, and has hindered our ability to understand the rate of progress or lack thereof to attain standards (element of second goal).
- Emissions reconciliation and inventory improvements: Emissions inventory improvement is probably the most important issue in the planning process. Methodologies continue to improve, but ambient measurements are required to allow comparison between emissions estimates and air quality and to suggest specific improvements to inventories (element of second goal).
- Mid course evaluation of SIP: With the ability to model more episodes, or even a season, better plans should be developed. However, aerometric data are needed to determine if the planning strategy is actually resulting in predicted reductions before regulatory deadlines occur. Such a mid course evaluation can lead to corrections if necessary. The California Air Resources Board now includes a commitment for mid-course evaluations in all of its ozone and PM SIPs. This objective was also endorsed by the EPA workgroups for ozone/PM/regional haze (element of second goal).
- Characterization of chemistry: An understanding of how precursor species have changed in response to reduction strategies is needed to improve our understanding of ozone and particulate matter formation and control (element of second goal).
- Population and area exposure: Both state law and good air quality management practices require that plans reduce health risk from criteria pollutants and air toxics (element of second goal).
- Source-receptor relationships: Improved source speciation profiles for pollutants and precursors will allow more unambiguous identification of sources that cause and/or contribute to high concentrations of criteria pollutants and air toxics (element of second and third goals).
- Equilibrium evaluations: Evaluation of chemical equilibrium and phase changes associated with pollutant formation, as well as examination of limiting conditions, reaction rates, precursors and catalysts, will allow investigation of integrated reduction strategies for optimal air quality improvement (element of third goal).
- Forecasting and reporting air quality: Additional data should aid in improved forecasting for air quality health advisories and agricultural and prescribed burns (element of fourth goal).

- Improve synoptic scale models: Utilize additional data to improve synoptic models and regional prediction methods used for air quality and smoke management forecasting (element of fourth goal).

TASKS FOR THE RFP:

Task 1: Design an aerometric network to satisfy the objectives listed above. The design should utilize available information to determine the types of monitors that should be employed to provide an effective surface and aloft ambient air quality and meteorological measurement network. The design should consider and describe options for securing aloft ambient air quality and meteorological measurements, including the potential use of satellite-derived measurements. The contractor is also encouraged to explore the possibility of improving routine measurement techniques. For example, one could consider further speciation of volatile organic compounds to include a larger number of chemicals than required by the Photochemical Assessment Monitoring protocol. This could improve air toxics analysis and emission inventory improvement efforts. Another improvement could be continuous measurements of pollutants such as ammonia and nitric acid. The design should include the recommended general geographic distribution of monitoring sites and selection criteria for sites that would be necessary to complete the network in accordance with the objectives. The rationale for including or excluding specified types of measurements at monitoring locations should be developed from the objectives and from consideration of the sensitivity of the instruments and methods relative to potential ambient concentrations. The rationale should be reported in the design document, including which objective(s) the measurements are designed to address. The relative priority for each measurement should be included to guide subsequent efforts to optimize and fund the enhanced network.

The design document should identify the purpose for including each type of monitor and the number of monitors of each type that will be required to complete the network. If a variety of instruments or methods are available for obtaining one or more of the specified measurements but a specific monitor or method is recommended, the basis for selection in comparison to other available technologies should be provided.

Task 2: Describe the requirements for QA/QC for types of monitors recommended, and resource needs that might be expected (manpower, equipment maintenance, laboratory analyses and equipment necessary to carry out such analyses, etc).

Task 3: Describe options for data archiving to support the various uses identified in the objectives, considering the current ARB CCAQS data archive system and state and federal air quality data reporting systems. Provide recommendations

for archiving methodologies and identify the additional computer assets that would be needed for such an archive.

Task 4: Recommend data analysis methods that can ensure the adequacy of the database as well as provide for the corroborative analyses that can complement air quality modeling. Document the justification for selecting each data analysis method, the benefits of conducting the analyses, and the scientific credibility of the method. Estimate, if possible, manpower and computational needs for these analyses.

Task 5: Using the above information, estimate the capital costs for each type of monitor, costs for annual operation and maintenance including manpower, laboratory and archiving, and costs for the types of analyses identified in Task 4. Provide a best estimate with an upper and lower bound.

References:

Fujita, E.; et al. *Central California Ozone Study (CCOS) – Volume I. Field Study Plan*. Version 3, Desert Research Institute, Reno, NV, November 24, 1999. Available at http://www.arb.ca.gov/airways/ccos/ccosmtgsdocs_v3.htm#documents

Fujita, E.; et al. *Central California Ozone Study (CCOS) – Volume II. Field Operations Plan*. Version 2, Desert Research Institute, Reno, NV, May 31, 2000.

Watson, J.G.; et al. *Aerometric Monitoring Program Plan for the California Regional PM2.5/PM10 Air Quality Study*. DRI Document No. 9801.1D5, Draft, Desert Research Institute, Reno, NV, December 20, 1998. Available at <http://www.arb.ca.gov/airways/crpaqs/publications.htm> .

ACCESS TO ADDITIONAL INFORMATION: Members of the CCOS Technical Committee prepared a paper, attached as an appendix to this RFP, as a preliminary effort to consider network enhancement for the San Francisco Bay Area and the Sacramento and San Joaquin Valleys. The preliminary design of the network described in this paper was based on modeling and data analysis carried out on ozone and particulate matter during the 1990 San Joaquin Valley Air Quality Study, the 1995 Integrated Monitoring Study for particulate matter, the 2000 Central California Ozone Study (CCOS) and the 2000 California Regional PM10/PM2.5 Air Quality Study (CRPAQS). Access to all final public reports for the above studies can be found at the following web sites maintained by the Air Resources Board:

<http://www.arb.ca.gov/airways/ccaqqs.htm>
ftp://ftp.arb.ca.gov/carbis/ptsd/ccaqqs_tac/ccaqqs_tac.htm

Draft reports may be made available on an as-needed basis for issues pertinent to this issue.

3. SCHEDULE

Respondents will be expected to meet the following milestones. Two meetings with the Technical Committee will be held, one at the initiation of the contract to discuss the workplan, and a final one at the midpoint of the contract to discuss progress. Shown below is an approximate time line for the various stages of this contract. Potential contractors can assume that comments on draft documents will be received within 45-days following submittal.

- Release of the RFP April 29, 2005
- Submission of bids May 17, 2005
- Contract Initiation Mid June 2005
- Submit draft workplan 1 month after contract initiation
- Submit final product 6 months after contract initiation

4. BUDGET

A budget maximum of \$100,000 has been established for the combined set of tasks contained in the scope of work presented in this RFP. Costs will be a factor in evaluating proposals. While proponents should be mindful of this, they should also endeavor to avoid underestimating costs.

5. ADMINISTRATION

The group selected to conduct this work will report to the ARB Program Manager. The period of performance of this contract will be 6 months with work expected to commence in approximately mid June of 2005. Contract performance is not to begin until a contract is fully approved by the San Joaquin Valleywide Air Pollution Study Agency.

6. CONTRACT REQUIREMENTS

A. Reporting and Other Requirements

The contractor shall deliver a draft workplan, based on the submitted proposal, and respond to recommended revisions.

The contractor will attend two one-day meetings at the beginning and midpoint of the project (assume meetings in Sacramento, California).

The contractor shall deliver monthly progress reports to the ARB Program Manager. Payment of invoices will not be made until receipt of the associated progress report.

The contractor shall deliver invoices to the ARB Program Manager. With respect to the payment period completed, the invoices shall set forth in detail by task, in accordance with the contract budget, charges for time expended on the project, including classification of personnel involved in such time expenditure, and the monthly, weekly, or hourly rates for such personnel, as appropriate. The invoices shall also contain an itemization of all materials used for the project, including the purpose of its use and its cost. All work billed for in each invoice must be covered in an associated progress report. Therefore, if invoicing is done more frequently than quarterly, progress reports coincident with the payment period must also be provided.

The contractor shall deliver a draft final report and a draft manuscript for publication in a peer-reviewed journal, each with one hard copy, one electronic copy in Adobe Acrobat (PDF) format, and one in Microsoft Word (DOC) format. In preparing the manuscript for publication, the contractor should commit to making appropriate contacts with investigators identified by the CCOS Technical Committee to discuss co-authorship and acknowledgements prior to publication. The contractor will receive comments on this report within 45 days of submission, with revisions due within 45 days after receipt of review comments (also with 2 hardcopies, PDF, and DOC versions). The contractor will be responsible for paying all costs associated with publication of the manuscript.

B. Correspondence

All technical correspondence regarding this contract should be sent to the Program Manager at the address listed below:

Mr. John DaMassa, Chief
Modeling & Meteorology Branch
Planning and Technical Support Division
California Air Resources Board
Program Manager
Central California Air Quality Studies
1001 "I" Street
Sacramento, California 95814

C. Contract Language

A copy of the contract language is presented in Appendix B. Any proposed revisions to the contract language **must** be included as part of the proposal. Questions regarding the contract should be directed to the JPA attorney at the address provided below:

Mr. Philip Jay
San Joaquin Valleywide Air Pollution Study Agency Counsel
San Joaquin Valley Unified Air Pollution Control District
1990 East Gettysburg Avenue
Fresno, California 93727
(559) 230-6033

7. PROPOSAL PREPARATION AND EVALUATION GUIDELINES

A. Proposal Contents

Proposals should convey a maximum of technical content related to the relevant task with a minimum of extraneous material. Proposals should convey a high degree of technical understanding and innovation while demonstrating the ability to present complex scientific results to technically qualified decision-makers. Vague references to “standardized”, “EPA”, “ARB”, or other unexplained and non-documented methods will be considered unresponsive and rejected.

The proposal should be clear and concise (typically not more than 30 pages maximum for each question or task, and preferably exclusive of resumes and proponent facilities/experience, which should also be minimal and can be incorporated by reference to a corporate web site). The proposal should address the following issues:

1. *The technical approach for answering each question/task.* The technical approach should build upon, verify or challenge, and add to existing knowledge. The technical approach should include re-formulation or better articulation of the tasks, a brief summary of current knowledge on the topic from central California and elsewhere (where relevant), available methods to answer the questions and a rationale for selecting the proposed method(s), a description of the analysis approach and the data to be used, methods to verify the generality of the results, methods to qualify the conclusions, and a brief outline for the final report and publication.
2. *Staffing, management oversight, and data management.* Extensive management oversight is not solicited or encouraged, as it is expected that each task will require substantial commitment and

participation of an experienced specialist in the area with appropriate delegation to support personnel.

3. *A brief statement of qualifications for the proposed participants and a description of the duties they will perform, including a specific discussion of relatively recent project experience.* Greater detail may be incorporated by reference to a corporate website (preferred) or as a standard package. Extensive corporate experience is not as important as the qualifications of the principals who will be dedicated to the proposed task.
4. *The estimated budget for each task should be summarized on the cost reporting form shown in Table 1.* This cost summary form should be supplemented with appended documentation detailing:
 - a. Commitments and hourly rates for personnel.
 - b. Types and costs for travel, equipment, or supplies procured as part of the project.
 - c. One-time costs that apply to all tasks, but that are only listed in one (identify the costs and the tasks in which they are included or excluded).
 - d. Expected cost increases such as annual salary adjustments should also be specified. It is anticipated that this contract will be awarded on a time and materials basis with a maximum (not to exceed) value.
5. *The management approach for dealing with routine operations, unexpected problems, and changes in work scope.*
6. *A project schedule, describing the start and end dates for each task, and the completion date for each deliverable specified in the scope of work.*

B. Guidelines and Criteria for Proposal Evaluation

Respondents should demonstrate knowledge and experience in the design and implementation of air quality and meteorological monitoring networks, along with expertise and experience with monitoring methods set up, operation, and maintenance, as well as QA/QC requirements. Respondents should also demonstrate knowledge and experience in data collection and archiving options. Respondents should also have experience in air quality modeling and complementary air quality analyses approaches and methods. The following specific criteria will be used to evaluate the proposals:

1. Technical approach for implementing the tasks specified under the Scope of Work. (30 points)
2. The experience, competence, capability, and commitment of the proposed personnel to be assigned to the project. (30 points)
3. The proponent's technical performance on similar, past projects and the extent to which the participant can draw directly on past experience in meeting the requirements of the RFP. (25 points)
4. The overall proposed cost of the work as well as cost-effectiveness, and the proponent's willingness to enter into a contractual agreement that minimizes the risk of cost overrun. (15 points)

C. Conflict of Interest Requirements

Government Code Section 1090 generally prohibits a public official from being financially interested in a contract which he or she has made or participated in an official capacity. Under certain circumstances, persons who perform work pursuant to a contract with a government agency may be subject to the restrictions of Government Code Section 1090.

With respect to CCOS, this means that based on participation in the planning of the Study, certain consultants are precluded from participating in all or some of the post-planning contracts. This preclusion would apply to these consultants as either a prime contractor or a subcontractor. In most cases, whether a particular consultant is eligible to bid will depend on an analysis of all of the circumstances surrounding the consultant's earlier participation in CCAQS and the work that the consultant now proposes to perform.

Any response to this RFP which includes a paid participant who is ineligible based on Government Code Section 1090 will be rejected during the format review of the proposals.

Questions concerning the eligibility of a potential bidder must be directed to the JPA attorney at the address provided below prior to the preparation of a proposal:

Mr. Philip Jay
San Joaquin Valleywide Air Pollution Study Agency Counsel
San Joaquin Valley Unified Air Pollution Control District
1990 East Gettysburg Avenue
Fresno, California 93727
(559) 230-6033

D. Submittal Requirements

An original and two (2) hardcopies of your proposal and an electronic PDF file of the proposal shall be sent with a cover letter to the ARB Program Manager, Mr. John DaMassa, at the address listed in the Contract Requirements section. Hand carried or express mail packages may be delivered to Mr. John DaMassa at the California Air Resources Board, 1001 "I" Street, Sacramento, California 95814.

TABLE 1 **PROPOSAL BUDGET SUMMARY**

DIRECT COSTS:

1. Labor & Employee Fringe Benefits (provide detailed breakdown by task and employee on separate sheet [including subcontractors]) \$ _____
2. Equipment (provide detailed breakdown on separate sheet) \$ _____
3. Travel & Subsistence
\$ _____
4. Electronic Data Processing \$ _____
5. Photocopying/Printing/Mail/Telephone/FAX \$ _____
6. Materials and Supplies \$ _____
7. Miscellaneous (please specify) \$ _____

TOTAL DIRECT COST: \$ _____

INDIRECT COSTS:

8. Overhead (specify rate) \$ _____
9. General & Administrative Expenses (specify rate) \$ _____
10. Other Indirect Costs (please specify) \$ _____
11. Fee or Profit (specify rate) \$ _____

TOTAL INDIRECT COST: \$ _____

TOTAL DIRECT AND INDIRECT COST: \$ _____

APPENDIX A

Conceptual Design of an Enhanced Multipurpose Aerometric Monitoring Network in Central California

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ABSTRACT

Results of previously conducted major ozone and particulate field programs, modeling from the 1990 San Joaquin Valley Air Quality Study, 2000 Central California Ozone Study, and 1999-2001 California Regional Particulate Matter Air Quality Study were used to develop a conceptual design of enhancements to the routine monitoring network that would reduce reliance on major field programs.

Central California Field programs established that sites covering a wider spatial scale than the urban NAMS/SLAMS regulatory network are essential for daily forecasting, data analysis and modeling of air quality. Measurements from temporary field study sites were valuable for analysis and photochemical modeling of episodes. Temporary sites

filled data gaps in the regulatory network that support analysis and modeling of criteria pollutants, precursors and air toxics. However, expensive major field programs do not provide continuing capacity to evaluate current episodes because they require years of preparation, analysis and modeling. Improved computer technology and capacity make evaluation, forecasting and modeling of current conditions possible, but existing ambient monitoring networks provide insufficient data to support detailed scientific analysis.

A working group of the Technical Committee for the Central California Air Quality Studies designed a conceptual central California monitoring network capable of supporting multiple objectives without requirement for a major field study. Objectives include support for daily pollutant forecasting, episode analysis and modeling and model evaluation to assess the response of ozone and other secondary pollutant formation to changes in precursor emissions. Design parameters addressed network issues including sufficient monitoring sites collecting surface and aloft measurements of meteorology, criteria pollutants and precursors to support evaluation of pollutant formation and ozone concentrations. Aerometric network enhancement design goals include improvement of trend evaluation, population exposure assessment, emissions reconciliation, transport assessment, tracking air quality progress from plan implementation and improvement of temporal and spatial representativeness in episode forecasting and modeling.

INTRODUCTION

This paper describes the goals, objectives, design criteria and resulting construct for a conceptual monitoring network enhancement for central California. The purpose is to develop and implement an aerometric monitoring network for central California to enhance effective air quality management for criteria pollutants and air toxics and track progress towards meeting regulatory requirements. The paper considers the possibility of making permanent changes to the existing routine monitoring network that would enhance the quality and quantity of aerometric data continuously collected. The importance of such an enhancement would be reduced reliance on major field program networks that provide only temporary data.

The complexity of meteorological and air quality assessment for central California requires collection of extensive upper air data and air quality and precursor measurements to support analysis and modeling. The location and number of compliance network monitoring sites meets federal requirements, but has limitations in defining the meteorological and air quality variations that have been addressed by temporary sites of major field programs. The lack of these temporary sites makes it more difficult to assess pollution episodes that occur when the field program measurements are not operational. Since field programs capture only a few episodes; we face concern about the representativeness of these episodes to characterize all episode types and conditions. Years after a major field program; we also become concerned about the reliability of using old modeling episodes with new emissions projections since we do not then have a means to evaluate base case correlation.

Requirements to forecast air quality on a daily basis will become more difficult in addressing PM_{2.5} and eight hour ozone predictions and would benefit from a more robust monitoring network. Even the existing PM₁₀ and one hour ozone forecasting would be improved by a dataset more similar to that provided by major field studies. Assessment of pollutant trends also suffers from variation in data density and comprehensiveness.

Considerable literature exists on the design of field monitoring networks for major studies for photochemical analysis, and extensive documentation is available from the United States Environmental Protection Agency on the design of compliance monitoring networks. This analysis is a first effort to evaluate how close we might be able to come to a network bridging between the two purposes. The use of instrumented aircraft, as are used in many major field programs, is not considered viable as part of daily operations of a permanent network due to cost, but is partially fulfilled by additional upper air and precursor measurements. Even without aircraft, the expense of an enhanced network may still be out of reach. However, analysis of a conceptual full time network is valuable to establish the framework for continued gradual improvement to reduce the differential between the existing network and the desired conceptual network.

BASIS

Over the past two decades, California has been a national leader in developing combined monitoring and air quality modeling programs to further the understanding of ozone and particulate matter formation and evaluate means to reduce these pollutants. These programs have been cooperative ventures managed by a consortium composed of Policy Committee and Technical Committee representatives of local, state and federal agencies and industrial stakeholders. Each program has been designed to collect aerometric data to address the data needs for modeling and data analysis. Each subsequent program has built on the experiences acquired in previous efforts, establishing optimized monitoring networks for the next field studies to minimize the number of sites and instruments required while maximizing the scientific accuracy and sufficiency to support modeling and data analysis.

The Technical Committee for the California Regional Air Quality Studies, comprised of users of aerometric data, the air quality modelers, planners and data analysts, reviewed the two most recent field studies, the Central California Ozone Study (CCOS) and the California Regional Particulate Matter Study (CRPAQS). The result of this review recognized the need to have a more robust aerometric monitoring network throughout the entire central California region to support modeling and analysis objectives. This network is not designed from the viewpoint of compliance monitoring; the intent is to evaluate the difference between the compliance network and a conceptual network that would support high quality meteorological and air quality assessment on a continuous basis similar to the data provided by the special data sets of major field studies.

GOALS OF PROGRAM

This conceptual network design is intended to provide data for the criteria pollutants, ozone and particulate matter, and their precursors, and air toxics, as well as surface and aloft meteorological data. The network would fulfil a void that now exists in the statewide monitoring network, which is predominantly a compliance network. The Technical Committee for the California Regional Air Quality Studies has developed a proposed long term air quality and meteorological (aerometric) monitoring network in Central California for the following goals:

- Provide capability to model any day: Modeling a single or a small number of episodes as the basis for planning does not capture the diverse number of episodes that lead to exceedances of standards (the San Joaquin Valley exceeds the federal one hour standard about 40 times per year). Reliance on a limited set of episodes may not lead to an integrated strategy that will provide the most effective guidance to reductions needed to meet that standard. A major impediment to modeling more episodes, or even modeling a pollutant season, is lack of adequate data for input to the air quality models, and for evaluation of such models to ensure that they are predicting historic concentrations for the right reasons. Only with a robust database will there be more confidence in attempts at modeling the entire ozone season.
- Support for ongoing data analysis: While modeling has been the primary tool for development of State Implementation Plans (SIPs), the trend is to view modeling as one of a number of tools to use in design of an effective strategy. Moreover, there is a need to have actual data to see if the strategy developed through modeling is actually leading to improvements in air quality. Data analysis is the mechanism by which to provide both independent corroboration of modeling results of historic episodes and to evaluate whether the predicted strategies are actually occurring in the real world over time. The lack of sufficient data to make this determination in the past has hindered our ability to understand whether mid-course corrections were needed for SIPs to keep us on track.
- Develop an integrated multi-pollutant strategy for air quality management: Planning has been done on a pollutant-by-pollutant basis. However, the precursors for ozone, particulate matter and air toxics are similar or the same. Consequently, it makes sense to develop an integrated planning process to minimize unintended consequences of a strategy for one pollutant adversely affecting a strategy for another. The ability to have sufficient data for modeling and analysis is critical to development and tracking of an integrated plan.
- Provide data to support districts, state and federal air quality forecasting, and other efforts such as smoke management and fire weather efforts. New SIPs may require intermittent control programs driven by pollutant dispersion and air quality forecasts. Continuous upper air meteorological have and will continue to enhance synoptic modeling for these efforts.

OBJECTIVES

A set of objectives has been defined to fulfill the above goals. These objectives are designed to meet the regulatory, scientific and technical needs that should ultimately build more confidence in the air quality management assessments of episodes not captured by field studies, long term trend analysis and short term analysis such as daily pollutant forecasting. While some objectives are independent of one another, others are interdependent, and most require similar data. The objectives also help define the types of analyses needed to provide the relevant information, and measurements needed for analysis. The major objectives are as follows:

- Trends for ozone, particulate matter and air toxics and their precursors: Long term monitoring is needed to determine if there is a trend, and to be able to quantify the trend. While the present network can be used to track criteria pollutants, tracking of precursors is inadequate, and has hindered our ability to understand the rate of progress or lack thereof to attain standards
- Population and area exposure: Both California state law and good air quality management practices require that plans reduce health risk from criteria pollutants and air toxics.
- Emissions reconciliation: Emissions inventory improvement is probably one of the most important issues in the planning process. Methodologies continue to improve, but ambient measurements are required to allow comparison between emissions models and air quality.
- Mid course evaluation of SIP: With the ability to model more episodes, or even a season, better plans should be developed. However, aerometric data is needed to determine if the planning strategy is actually resulting in predicted reductions before regulatory deadlines occur. Mid course evaluation can lead to corrections if necessary. This objective was endorsed as part of the EPA Federal Advisory Committee for ozone/PM/regional haze.
- Transport assessment: Most assessments are usually dependent on surface meteorological measurements and ozone measurements. While these assessments may identify transport pathways, they cannot describe the related air chemistry needed to improve mitigation measures.
- Forecasting and reporting air quality: Additional data should aid in improved forecasting for air quality health advisories and agricultural and prescribed burns. Data would also improve synoptic scale models that are used for air quality and smoke management forecasting.
- Characterization of chemistry: An understanding of how precursor species have changed in response to reduction strategies is needed to improve our understanding of ozone and particulate matter formation and control.
- Source-receptor relationships: Improved speciation of precursors should, coupled with better profiles of source emissions, allow more unambiguous identification of sources that cause and/or contribute to high concentrations of criteria pollutants and air toxics.

- Routine air quality modeling: It is not possible at the present to set up and simulate an episode that has recently occurred, yet having the ability to do so would enhance the understanding of ozone formation for the specific episode and whether strategies developed for the SIP would be effective. The envisioned monitoring network, along with near real time access to it would allow this type of modeling.
- Surface and aloft meteorology: Many of the identified objectives require much more robust collection of surface and aloft winds, temperature, and humidity measurements in order to work.

DESIGN CRITERIA

Prior ozone studies have identified mesoscale meteorological features that are important to ozone and precursor transport and formation in Central California including mesoscale eddies, valley and slope flows, marine intrusion, and spatial temperature gradients that characterize transport in Central California. A surface and upper level meteorological network should provide adequate spatial density and temporal resolution to evaluate mesoscale meteorological models that characterize and define these features. The spatial and temporal coverage should also be sufficient to perform data analyses that corroborate findings from air quality models.

Ozone studies done in 1990 (SJVAQS/AUSPEX/SAQM) and 2000 (CCOS) utilized networks designed to capture the meteorological features mentioned above. With the knowledge gained through the SJVAQS study, the CCOS monitoring network was optimized to reduce the number of sites and resources needed. CCOS established a high-density meteorological network that supports photochemical modeling in Central California. The CCOS network was used as a starting point for the conceptual network design. It is envisioned that the long-term network would be optimized for spatial and temporal coverage and cost with analysis of CCOS data.

While specific data analysis techniques have not been identified for this exercise, we can look at the different data analysis methods and techniques that have been incorporated into the earlier California air quality studies using aerometric data from the 1985 Southern San Joaquin Valley Ozone Study, the 1990 San Joaquin Valley Air Quality Study (SJVAQS), the 2000 Central California Ozone Study, the 1995-1996 Integrated Monitoring Study for Particulate Matter, and the California Regional Particulate Matter Air Quality Study. Most of these studies were designed to answer specific questions that could be addressed by a variety of analysis techniques, as well provide data identified as necessary for air quality model simulations and performance evaluation. It is anticipated that the next iteration of the monitoring network will take into account the specific needs for individual data analysis methods into the design so that temporal, spatial, accuracy and precision needs are explicitly incorporated into the overall design of a monitoring network.

Review of the field program plan for CCOS¹ and several relevant papers produced from the SJVAQS program^{2,3,4,5,6,7,8} provide criteria and parameters for monitoring site and measurement selection.

Site Selection Design Criteria

- *Design to meet scientific, technical and regulatory needs for central California for criteria and non-criteria pollutants*
- *Define sites and measurements to support daily forecasting, capture the meteorological initial conditions and pattern for every episode, enhance precursor and criteria trend analysis and improve air quality modeling for episodes not captured by major field studies*
- *Detect temporal and spatial precursor limitations that vary for different episodes*

Meteorology Parameters to Capture

- *Sea breeze*
- *On/offshore and coastal flows*
- *Marine fog & stratus*
- *Marine air intrusion*
- *Mixing depth/Inversion strength*
- *Convergence zones*
- *Upslope/downslope flows*
- *Bifurcation of delta flow*
- *Up/down valley flows*
- *Eddies and Jets*
- *Complex flows and velocities via passes*
- *Synoptic deformation, subsidence*

CENTRAL CALIFORNIA MONITORING NETWORK

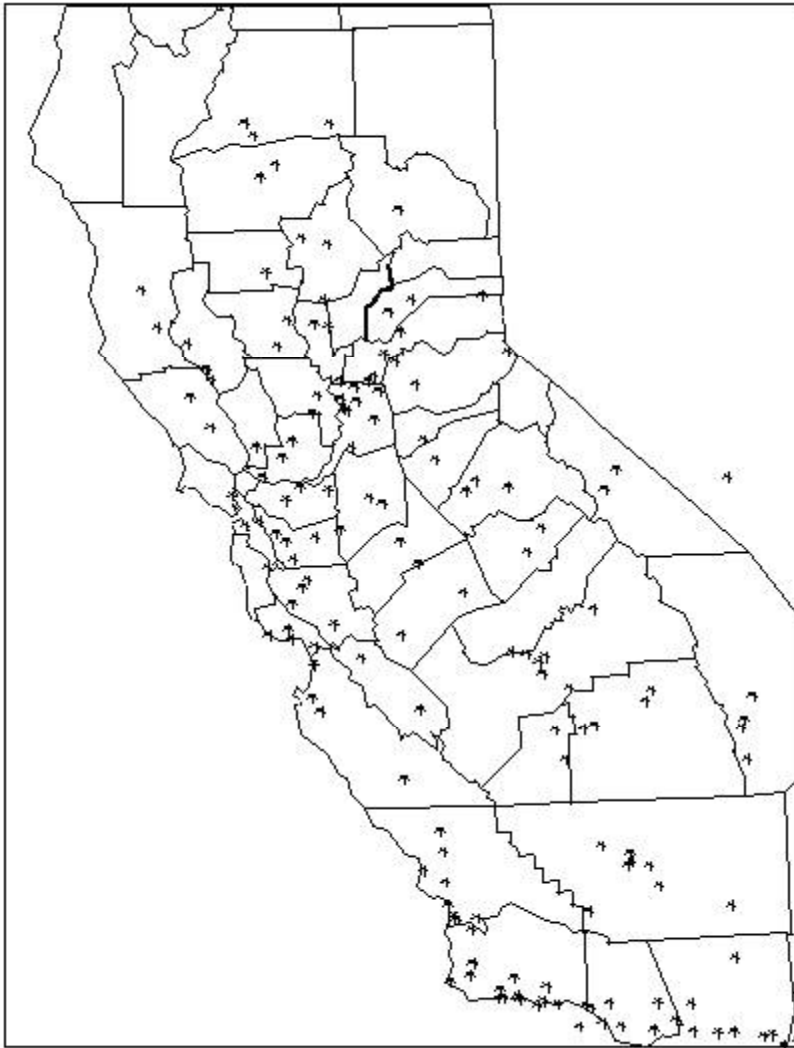
Based on the identified goals and objectives, a preliminary design of an enhanced multipurpose aerometric monitoring network for central California has been developed.

The initial network design would cover the Bay Area, the Sacramento and San Joaquin Valleys and the surrounding mountain counties-the primary region encompassed in both CCOS and CRPAQS.

Network enhancements are identified only for measurement of upper air movement and temperature, upgraded and added monitors for NO_y and additional precursor measurements through VOC canister sampling. Aircraft measurements are not considered as viable for a continuous daily sampling network. While a number of additional monitoring devices have been utilized in major field studies to learn more about atmospheric chemistry, this conceptual network is confined to only those measurements essential to meteorological and air quality representation of episodes. The additional technical information gained from field studies will be used to interpret the import of these more basic measurements.

Figure 1 shows the existing air quality monitoring stations. Figure 2 shows the existing air quality monitoring stations and the proposed NO_y measurements. Figure 3 shows the existing air quality monitoring stations and the proposed VOC measurements. Figure 4 shows the locations of the existing and proposed upper air meteorological monitoring stations.

Figure 1 Existing air quality monitoring stations marked by black stars.



Approximately 185 air quality and meteorology sites are in operation. Ozone monitors are operated at 130 sites, NO_x is monitored at 76 sites, 11 sites monitor VOC (PAMS) and 8 sites have upper air monitoring.

Figure 2 Existing air quality monitoring stations and the proposed NO_y measurements.

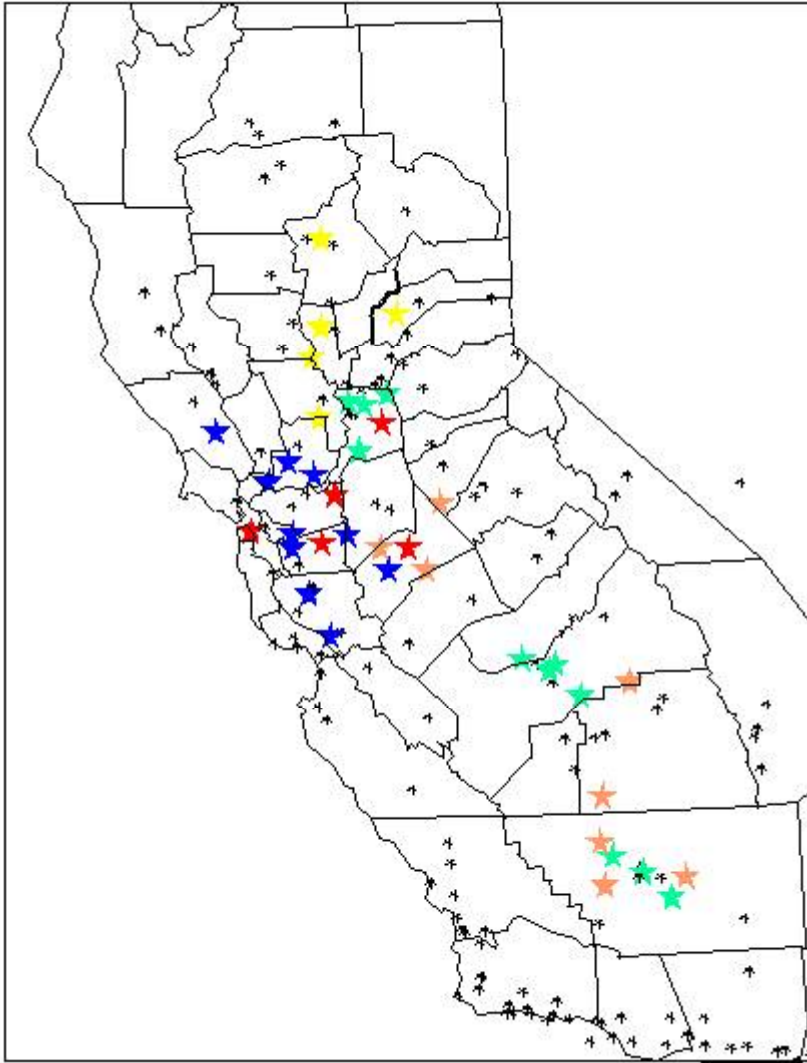


Figure 2 black stars show the locations of the existing stations. Green stars show the locations of the PAMS stations where NO_y measurements are proposed to be added. Blue, yellow and orange stars show the proposed NO_y measurements in the Bay Area, Sacramento Area, and the San Joaquin Valley, respectively.

PAMS stations: Elk Grove-Bruceville, Sacramento-Airport Road, Sacramento-Del Paso, Folsom-50 Natomas Street, Madera, Clovis Villa, Fresno-1st Street, Parlier, Bakersfield-Golden State, Arvin, and Shafter.

Proposed Bay Area NO_y measurements: Morgan Hill/Gilroy, Labmby Road, Castro Valley, Vallejo, San Jose, Santa Rosa, Livermore, Bethel Island, Patterson Pass, Crater Peak,

Proposed San Joaquin Valley NO_y measurements: Tracy, Modesto, upwind areas of Modesto, downwind areas of Modesto, Kern Wild Refuge, Early Mart, south east of Elk Hills, east of Stockton, east of Fresno and east of Bakersfield. The last 3 stations are over foothills.

Proposed Sacramento Area NO_y measurements: Walnut Grove tower, Davis/Dixon, Sloughhouse, north of Woodland, Sutter Buttes, north of Sutter Buttes and Grass Valley.

Figure 3 VOC Measurement Sites

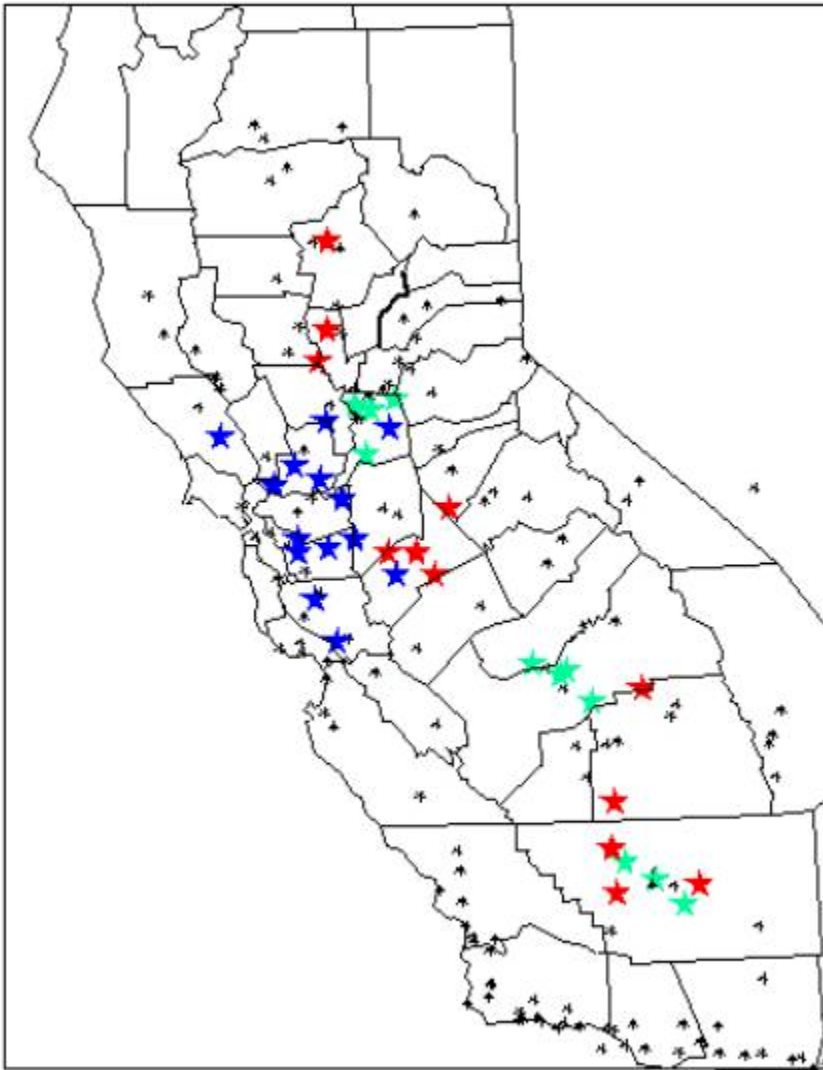


Figure 3 shows existing air quality monitoring stations and the proposed VOC measurements. Black stars show the locations of the existing stations. Green stars show the locations of the PAMS stations. Blue and red stars show the proposed VOC measurements in the region. An assessment study is suggested at the stations with red stars to verify whether VOC levels are above the minimum detection limit.

PAMS stations: Elk Grove-Bruceville, Sacramento-Airport Road, Sacramento-Del Paso, Folsom-50 Natomas Street, Madera, Clovis Villa, Fresno-1st Street, Parlier, Bakersfield-Golden State, Arvin, and Shafter.

Proposed Bay Area VOC measurements: Morgan Hill/Gilroy, Labmby Road, Castro Valley, Vallejo, San Jose, Santa Rosa, Livermore, Bethel Island, Patterson Pass, Crater Peak,

Proposed San Joaquin Valley VOC measurements: Tracy, Modesto, upwind areas of Modesto, downwind areas of Modesto, Kern Wild Refuge, Early Mart, south east of Elk Hills, east of Stockton, east of Fresno and east of Bakersfield. The last 3 stations are over foothills.

Proposed Sacramento Area VOC measurements: Walnut Grove tower, Davis/Dixon, Sloughhouse, north of Woodland, Sutter Buttes, and north of Sutter Buttes.

Figure 4 Upper Air Measurement Sites

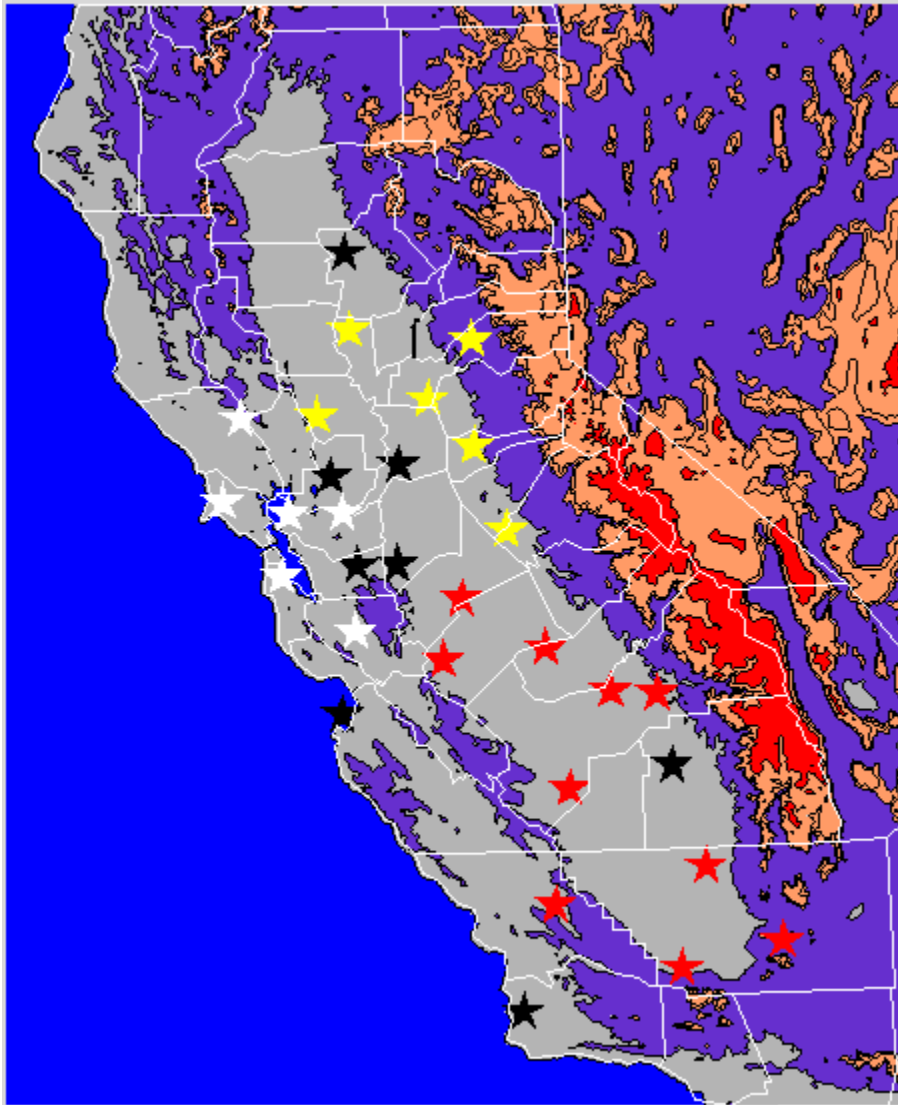


Figure 4 black stars show the existing upper air measurement stations. White, yellow and red stars show the proposed stations in the Bay Area, Sacramento Area and the San Joaquin Valley, respectively.

Existing upper air meteorological stations (black stars): Livermore, Tracy, Fairfield (Travis Air Force Base), Monterey, Bruceville, Near Chico (ARB site), Visalia, and Vendenberg Air Force Base. In addition the National Weather Service makes twice a day rawinsonde measurements in Oakland (not shown).

Proposed upper air meteorological stations in the Bay Area (white stars): Point Reyes, San Francisco-Mendocino County corridor, central Bay Area, South Bay (San Jose), North Bay (Richmond or north of Richmond) and Delta Region.

Proposed upper air stations in the Sacramento Area (yellow stars): Pleasant Grove (not show, but located in lower Sutter County), west of Woodland, north of Sutter Buttes, Jackson, Granite Bay and Cool.

Proposed upper air stations in the San Joaquin Valley (red stars): Arvin, west of Modesto, San Luis Reservoir, Chowchilla, Fresno, Huron, Mouth of Kings River, Tehachapi exit, Carrizo Plain, south west of the Valley.

Network Costs

One of the factors in the design of this preliminary network was that cost would not constrain the design. Any adjustments necessary for implementation based on cost should follow after establishing a design on technical and scientific requirements. It is recognized that start up costs will be in the millions of dollars, and operation of the network will also be costly. The cost for implementation and operation of the preliminary network has only been done in a “back of the envelope” sense, and that estimate was approximately ten million dollars. Provisions will need to be made to provide support for staff and costs for local agencies and the California Air Resources Board (ARB). However, optimizing the anticipated costs for new control strategies and the resultant benefits in improved health are expected to far outweigh the network costs.

In addition, there appear to be opportunities to leverage some of the costs with other agency needs and with programs being funded and being considered for funding through the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service. NOAA already has initiated a program to provide much better winter storm forecasts, which can aid in emergency preparedness activities. As part of this activity, NOAA is proposed the development of an aloft meteorological network in coastal and inland California. There appears to be real synergy between what NOAA is looking at for an extended period, and the meteorological needs foreseen in the long term monitoring effort of the conceptual network. NOAA worked with our study agency for CCOS and CCOS data analysis, partially supported by funds allocated in the federal budget for CCOS.

Temperature forecasting will become an even more important tool in maximizing energy usage effectively to meet the increased demand for energy. Much effort is being expended on developing better air quality forecasting tools for both agricultural and prescribed burns, as required by state law. Other areas in which the monitoring network could directly or indirectly play a major role would be better water resources management and fire weather forecasting.

Data analysis costs

As mentioned above, the prime use of the data, aside from modeling, will be data analysis to meet the multiple objectives. Once the analysis methodologies are better defined, costs can be estimated for doing the analyses. These costs will have to be factored into the overall cost of the program.

CONCLUSIONS

The conceptual aerometric monitoring program for Central California was developed by modelers, planners, air quality and meteorological specialists of the Technical Committee of the California Regional Air Quality Studies to evaluate the potential to establish a monitoring network that would support evaluation of air pollution episodes, seasons and trends with reduced reliance on major field programs but better scientific and technical comprehensiveness than is provided by the existing compliance network.

The monitoring requirements for the conceptual design were determined by knowledge gained from analysis and photochemical modeling of the aerometric data assembled from several major field studies which established valuable monitoring sites that were decommissioned at the end of each study. Review of the existing compliance network in comparison to the supplemental networks established for major field studies and review of monitoring criteria to support meteorological and air quality data analysis and modeling were used to determine monitoring sites and measurement instruments of the conceptual network. Infrastructure implementation costs have been estimated, but do not include costs for operations, maintenance, data archiving, data analysis and modeling.

As perceived by the Technical Committee, implementing an enhanced network would be of substantial value for many regulatory objectives and would provide data to integrate assessment and planning for precursors common to ozone, particulate matter and air toxics. Providing a network that continuously provides meteorological and air quality data comparable to data provided by field studies would improve: evaluation of plan implementation effectiveness, modeling of episodes not captured by major field studies, daily forecasting and other real-time analysis.

Next steps:

The conceptual network design will be available for evaluation and revision by the Policy Committee for the Central California Air quality Studies and its member agencies. The design may be used as a resource for consideration of monitoring equipment purchases and monitoring site selection decisions. The conceptual network requires assets in excess of resources for maintaining a monitoring network that are currently available to the members. Full implementation of the conceptual network is dependent on acceptance of the design as a project to be considered for execution and successful identification of funding sources for infrastructure and operations costs.

REFERENCES

- 1 Fujita, E; Keislar, R.; Ranzieri, A.J.; Tanrikulu, S.; et al.; Central California Ozone Study (CCOS), Volume I and II, Field Study Plan, 1999 and 2000.
- 2 Roth, P.M.; Hansen, D.A.; Ranzieri, A.J.; Thuillier, R.H.; Planning Grid-based Air Quality Simulation Modeling Scope, Approach, and Design; Planning and Managing Regional Air Quality; Ed. Solomon, P.A. 1994 ISBN 1-56670-059-0; LC 93-29036.
- 3 Seigneur, C.; Chinkin, L.R.; Morris, R.E.; Kessler, R.C.; Conceptual Plan for Air Quality and Meteorological Modeling in the San Joaquin Valley; Planning and Managing Regional Air Quality; Ed. Solomon, P.A. 1994 ISBN 1-56670-059-0; LC 93-29036.
- 4 Blumenthal, D.L.; Watson, J.G.; SJVAQS/AUSPEX Collaborative Field Study Plan; Planning and Managing Regional Air Quality; Ed. Solomon, P.A. 1994 ISBN 1-56670-059-0; LC 93-29036.
- 5 Blumenthal, D.L.; Lurmann, F.W.; Design Rationale for the SJVAQS/AUSPEX Meteorological and Air Quality Measurement Network to Support Regional Air Quality Modeling and Analysis; Planning and Managing Regional Air Quality; Ed. Solomon, P.A. 1994 ISBN 1-56670-059-0; LC 93-29036.
- 6 Ranzieri, A.J.; Thuillier, R.H.; SJVAQS and AUSPEX: a Collaborative Air Quality Field Measurement and Modeling Program; Planning and Managing Regional Air Quality; Ed. Solomon, P.A. 1994 ISBN 1-56670-059-0; LC 93-29036.
- 7 Watson, J.G.; Roth, P.M.; Blumenthal, D.L.; Ranzieri, A.J.; Solomon, P.A.; Thuillier, R.H.; Recommendations on Planning a Large-scale Combined Monitoring and Modeling Effort Based on the SJVAQS/AUSPEX Air Quality Study; Planning and Managing Regional Air Quality; Ed. Solomon, P.A. 1994 ISBN 1-56670-059-0; LC 93-29036.
- 8 Roberts, P.T.; Lindsey, C.G.; Smith, T.B.; Analyses of San Joaquin Valley Air Quality and Meteorology; Planning and Managing Regional Air Quality; Ed. Solomon, P.A. 1994 ISBN 1-56670-059-0; LC 93-29036.

KEY WORDS

Aerometric
Monitoring
Network
Design
California
Modeling
Forecasting

APPENDIX B

CONTRACT LANGUAGE

CONTRACT NO. 05-x CCOS

SAN JOAQUIN VALLEYWIDE AIR POLLUTION STUDY AGENCY

AND

CONTRACTOR

This Agreement, which shall be effective upon the *DATE*, by and between the SAN JOAQUIN VALLEYWIDE AIR POLLUTION STUDY AGENCY (hereafter "STUDY AGENCY"), a joint powers agency, and *CONTRACTOR* (hereafter "CONTRACTOR").

WITNESSETH:

WHEREAS, STUDY AGENCY has the need to *TASK*;

WHEREAS, STUDY AGENCY released its Request for Proposal entitled "*RFP TITLE*" dated *DATE* ("the RFP"), which is incorporated herein, to those persons determined by STUDY AGENCY to be capable of *TASK*

WHEREAS, CONTRACTOR responded to said RFP by sending STUDY AGENCY its Proposal, dated *DATE*, ("the Proposal"), which is incorporated herein;

WHEREAS, STUDY AGENCY has requested CONTRACTOR to perform such services pursuant to the terms and conditions of its RFP; and

WHEREAS, CONTRACTOR represents that it is willing and able to perform the foregoing services requested by STUDY AGENCY pursuant to the terms and conditions thereof.

NOW, THEREFORE, the parties hereby agree as follows:

1. EMPLOYMENT OF CONTRACTOR

1.1 STUDY AGENCY shall employ CONTRACTOR as an independent contractor to provide, to the reasonable satisfaction of the STUDY AGENCY, those expert consulting services requested to be performed pursuant to Exhibit A of this Agreement, "Scope of Work," which is attached hereto and incorporated herein, the RFP, and the Proposal. In the event of any conflict between or among the terms and conditions of this Agreement, the exhibits incorporated herein, and the documents referred to and incorporated herein be resolved by giving precedence in the following order of priority:

1.1.1 To the text of this Agreement, Exhibit A, "Scope of Work," to this Agreement, Exhibit B, "Schedule of Deliverables"; and

1.1.2 To the RFP.

1.2 In addition to those obligations stated in paragraph 1.1 of this Agreement, CONTRACTOR shall provide STUDY AGENCY with one (1) reproducible master copy of each written work product completed pursuant to this Agreement, one (1) bound copy of each written work product, one (1) electronic copy in Adobe Acrobat, and one (1) electronic copy in Microsoft Word.

1.3 All work product that CONTRACTOR shall deliver to STUDY AGENCY hereunder shall be performed according to the work schedule and deadlines for performance identified in Exhibit B, "Schedule of Deliverables," to this Agreement, which is attached hereto and incorporated herein.

1.4 CONTRACTOR shall provide its services through the following key persons: *KEY PERSONS*.

1.5 It is the express intent of the parties to preserve the respective teams of the aforementioned key persons through the entire term of this Agreement. In case of death, illness, or other incapacity of any of the foregoing key persons, CONTRACTOR shall use its best efforts to promptly provide a replacement key person of at least equal professional ability and experience as the key person replaced,

without additional cost to STUDY AGENCY. CONTRACTOR may add to or replace persons on its support staff without STUDY AGENCY's approval, provided, however, that replacement support staff personnel shall be of at least equal ability as the person(s) replaced. Notwithstanding anything else stated to the contrary in this Agreement, it is understood that CONTRACTOR may not replace any of the aforementioned key persons without the prior, express written approval of the STUDY AGENCY.

1.6 Subject to any express limitations established by STUDY AGENCY as to the degree of care and amount of time and expense to be incurred and any other limitations expressly contained in this Agreement, CONTRACTOR shall perform the services under this Agreement with that level of due care and skill ordinarily exercised by other qualified professional consultants in the field of CONTRACTOR's expertise under similar circumstances at the time the services are being performed.

1.7 CONTRACTOR may retain such subcontractors and/or subconsultants as CONTRACTOR deems necessary to assist CONTRACTOR in completing the work under this Agreement. Such subcontractors and subconsultants, if any, shall be expressly approved in writing by STUDY AGENCY before they are retained to perform work under this Agreement. CONTRACTOR's use of any such subcontractors or subconsultants shall not, in any way whatsoever, relieve CONTRACTOR of its obligations under subparagraph 1.1 of this Agreement. It is understood that CONTRACTOR shall be STUDY AGENCY's sole point of contact in the performance of the services covered by this Agreement.

1.8 CONTRACTOR's obligation under this Agreement shall be deemed discharged only after all tasks identified in paragraph 1.1 have been completed and approved by the STUDY AGENCY "Technical Committee."

2. NO THIRD-PARTY BENEFICIARIES

2.1 It is understood that CONTRACTOR's services under this Agreement are being rendered only for the benefit of STUDY AGENCY, and no other

person, firm, corporation, or entity shall be deemed an intended third-party beneficiary of this Agreement.

3. TERM

3.1 This Agreement shall become effective upon execution by the parties and shall continue until terminated as provided herein. In no event shall the term of this Agreement extend past *DATE*, without the express, written consent of the parties hereto.

4. TERMINATION

4.1 STUDY AGENCY shall have the right to terminate this Agreement at its discretion, and without cause, at any time upon the giving to CONTRACTOR thirty (30) days' advance, written notice of an intention to terminate. If STUDY AGENCY terminates this Agreement in such event, CONTRACTOR shall be compensated for services satisfactorily provided to STUDY AGENCY up to the date of termination, as reasonably determined by STUDY AGENCY, together with such additional services performed after termination which are expressly authorized in writing by STUDY AGENCY to wind up such work.

4.2 The parties hereto may mutually agree to terminate this Agreement at any time, and in such case, upon any terms as are mutually agreeable, provided that such agreement is made pursuant to a written amendment to this Agreement.

4.3 CONTRACTOR shall have the right to terminate this Agreement immediately if:

4.3.1 STUDY AGENCY defaults in the payment of any sum due to be paid to CONTRACTOR; and

4.3.2 Such default for failure to pay or failure to perform any other obligation hereunder continues thirty (30) days after written notice thereof has been provided by CONTRACTOR to STUDY AGENCY.

4.4 Breach of Agreement: STUDY AGENCY may immediately suspend or terminate this Agreement, in whole or in part, where in the determination of STUDY AGENCY there is:

4.4.1 An illegal or improper use of funds;

4.4.2 A failure to comply with any term of this Agreement;

4.4.3 A substantially incorrect or incomplete report submitted to STUDY AGENCY;

4.4.4 Improperly performed services; or

4.4.5 Any other breach of the Agreement.

In no event shall any payment by STUDY AGENCY constitute a waiver by STUDY AGENCY of any breach of this Agreement or any default which may then exists on the part of CONTRACTOR. Neither shall such payment impair or prejudice any remedy available to STUDY AGENCY with respect to the breach or default. STUDY AGENCY shall have the right to demand of CONTRACTOR the repayment to STUDY AGENCY of any funds disbursed to CONTRACTOR under this Agreement which in the judgment of STUDY AGENCY were not expended in accordance with the terms of this Agreement. CONTRACTOR shall promptly refund any such funds upon demand.

In addition to immediate suspension or termination, STUDY AGENCY may impose any other remedies available at law, in equity, or otherwise specified in this Agreement.

In the event of any breach of this Agreement, STUDY AGENCY, upon the recommendation of the Policy Committee, may, without prejudice to any of its other legal remedies, terminate this Agreement upon five (5) days' written notice to CONTRACTOR. In such event, STUDY AGENCY shall pay CONTRACTOR only the reasonable value of

the services theretofore rendered by CONTRACTOR as may be agreed upon by the parties or determined by a court of law, but not in excess of the total Agreement price.

5. DATA

5.1 No reports, professional papers, information, inventions, improvements, discoveries or data obtained, prepared, assembled, or developed by CONTRACTOR pursuant to this Agreement shall be released or made available (except as otherwise provided herein) without prior written approval of the Chief of the Modeling and Meteorology Branch, Planning & Technical Support Division, Air Resources Board. The consent of the Chief of the Modeling and Meteorology Branch, Planning & Technical Support Division, Air Resources Board, shall not be unreasonably withheld.

5.2 All models used must be in the public domain. All model codes, inputs, and outputs, and data obtained, prepared, assembled or developed shall be provided to the Program Manager in a magnetic media acceptable to the Program Manager

6. REPORTS

6.1 CONTRACTOR shall place the following language in a conspicuous place on all monthly progress reports and on the final report:

"The statements and conclusions in this report are those of the Contractor and not necessarily those of the California Air Resources Board, the San Joaquin Valleywide Air Pollution Study Agency, or its Policy Committee, their employees or their members. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products."

7. COMPENSATION/INVOICING

7.1 STUDY AGENCY agrees to pay CONTRACTOR and CONTRACTOR agrees to receive compensation at the rate specified in paragraph 7.6 of this Agreement.

7.2 The amount to be paid to CONTRACTOR under this Agreement includes all sales and use taxes incurred pursuant to this Agreement, if any, including any such taxes due on equipment purchased by CONTRACTOR. CONTRACTOR shall not receive additional compensation for reimbursement of such taxes and shall not decrease work to compensate therefor.

7.3 Advance payments shall not be permitted. Payments will be permitted only at which time-equivalent services have been satisfactorily rendered. Progress payments shall be subject to review by the ARB Program Manager and the STUDY AGENCY Technical Committee. Progress payments shall be made monthly upon receipt of an invoice, a monthly progress report, and a claim for payment form, which is attached as Exhibit C and incorporated herein by reference. Invoices will be sent to Chief, Modeling and Meteorology Branch, Planning & Technical Support Division, Air Resources Board, P.O. Box 2815, Sacramento, CA 95812. With respect to the payment period completed, the invoice shall set forth in detail, in accordance with the Agreement budget, charges for time expended on the project, including the classification of personnel involved in such time expenditure, and the monthly, weekly, or hourly rates for such personnel, as appropriate. The invoice shall also contain an itemization of all materials used for the project, including the purpose of their use and their cost. Payment shall be made within thirty (30) days of receipt of the invoice.

7.4 Concurrently with the invoice, CONTRACTOR shall certify (i.e., through copies of issued invoices, checks, or receipts) that complete payment has been made to any and all subcontractors and subconsultants as provided.

7.5 It is understood that all expenses incidental to CONTRACTOR's performance of services under this Agreement shall be borne exclusively by CONTRACTOR.

7.6 In no event shall compensation paid by STUDY AGENCY to CONTRACTOR for the performance of all services under this Agreement exceed COST.

7.7 STUDY AGENCY shall be solely responsible for payment and not any of the parties to the Joint Powers Agreement forming the STUDY AGENCY.

7.8 STUDY AGENCY shall withhold payment equal to ten percent (10%) of each monthly invoice until completion of work requested by the STUDY AGENCY Technical Committee on the tasks specified in Exhibit A and approval by the ARB Program Manager and the STUDY AGENCY Technical Committee. It is CONTRACTOR's responsibility to submit an invoice in triplicate for the ten percent (10%) withheld.

7.9 The terms of this Agreement and the services to be provided thereunder are contingent on the approval of funds by the appropriating government agency. Should sufficient funds not be allocated, the services provided may be modified or this Agreement terminated at any time by giving CONTRACTOR thirty (30) days' prior written notice.

8. EXTRA SERVICES

8.1 CONTRACTOR shall not undertake any extra services not enumerated herein unless expressly authorized by STUDY AGENCY through an amendment to this Agreement, which shall be executed in the same manner as this Agreement, or by express, written authorization if such extra services are being performed by CONTRACTOR to wind up its services under this Agreement pursuant to subparagraph 4.1 of this Agreement.

8.2 When such extra services are being performed, CONTRACTOR shall keep complete records showing that STUDY AGENCY requested such extra services, the hours and description of activities worked by each person who worked on the project, the reason for such extra services, and all the costs and charges applicable to the extra services authorized.

9. INDEPENDENT CONTRACTOR

9.1 In performance of the work, duties, and obligations assumed by CONTRACTOR under this Agreement, it is mutually understood and agreed that CONTRACTOR, including any and all of CONTRACTOR's officers, agents, and employees, will at all times be acting and performing as an independent contractor, and shall act in an independent capacity and not as an officer, agent, servant, employee, joint venturer, partner, or associate of the STUDY AGENCY or the Policy Committee.

9.2 Furthermore, STUDY AGENCY shall have no right to control, supervise, or direct the manner or method by which CONTRACTOR shall perform its work and function. However, STUDY AGENCY shall retain the right to administer this Agreement so as to verify that CONTRACTOR is performing its obligations in accordance with the terms and conditions thereof. CONTRACTOR and STUDY AGENCY shall comply with all applicable provisions of law and the rules and regulations, if any, of governmental authorities having jurisdiction over matters the subject thereof.

9.3 Because of its status as an independent contractor, CONTRACTOR shall have absolutely no right to employment rights and benefits available to STUDY AGENCY employees. CONTRACTOR shall be solely liable and responsible for providing all legally required employee benefits. In addition, CONTRACTOR shall be solely responsible and save STUDY AGENCY harmless from all matters relating to payment of CONTRACTOR's employees, including compliance with

Social Security, withholding, and all other regulations governing such matters. It is acknowledged that during the term of this Agreement, CONTRACTOR may be providing services to others unrelated to STUDY AGENCY or to this Agreement.

10. MODIFICATION

10.1 Any matters of this Agreement may be modified from time to time by the written consent of all the parties without, in any way, affecting the remainder.

11. NON-ASSIGNMENT

11.1 Neither party shall assign, transfer, or subcontract this Agreement nor their rights or duties under this Agreement without the prior, express written consent of the other party.

12. INDEMNIFICATION

12.1 CONTRACTOR agrees to indemnify, save, hold harmless, and at STUDY AGENCY's request, defend STUDY AGENCY, its boards, committees, representatives, officers, agents, and employees from and against any and all costs and expenses (including reasonable attorneys fees and litigation costs), damages, liabilities, claims, and losses (whether in contract, tort, or strict liability, including, but not limited to, personal injury, death, and property damage) occurring or resulting to STUDY AGENCY which arises from any negligent or wrongful acts or omissions of CONTRACTOR, its officers, agents, subcontractors, subconsultants, or employees in their performance of this Agreement, and from any and all costs and expenses (including reasonable attorneys fees and litigation costs), damages, liabilities, claims, and losses (whether in contract, tort, or strict liability, including, but not limited to, personal injury, death, and property damage) occurring or resulting to any person, firm, corporation, or entity who may be injured or damaged when such injury or damage arises from any negligent or wrongful acts, or omissions of CONTRACTOR, its officers, agents, subcontractors, subconsultants, or employees in their performance of this Agreement.

13. INSURANCE

13.1 Without limiting STUDY AGENCY's right to obtain indemnification from CONTRACTOR or any third parties, CONTRACTOR, at its sole expense, shall maintain in full force and effect the following insurance policies throughout the term of this Agreement:

13.1.1 Comprehensive general liability insurance with minimum limits of coverage in the amount of _____ Million Dollars (\$) per occurrence;

13.1.2 Commercial automobile liability insurance for owned and non-owned vehicles which covers bodily injury and property damage with a combined single limit with minimum limits of coverage in the amount of _____ Million Dollars (\$) per occurrence;

13.1.3 Workers Compensation Insurance, in accordance with California law.

13.2 Such insurance policies shall name STUDY AGENCY, its officers, agents, and employees, individually and collectively, as additional insured but only insofar as the operations under this Agreement are concerned. Such coverage for additional insured shall apply as primary insurance, and any other insurance, or self-insurance, maintained by STUDY AGENCY, its officers, agents, and employees shall be excess only and not contributing with insurance provided under CONTRACTOR's policies herein. This insurance shall not be cancelled or changed without a minimum of thirty (30) days' advance, written notice given to STUDY AGENCY.

13.3 Prior to the commencement of performing its obligations under this Agreement, CONTRACTOR shall provide certificates of insurance on the foregoing policies, as required herein, to STUDY AGENCY stating that such insurance coverages have been obtained and are in full force; that STUDY AGENCY, its officers, agents, and employees will not be responsible for any premiums on the policies; that

such insurance names STUDY AGENCY, its officers, agents, and employees, individually and collectively, as additional insured, but only insofar as the operations under this Agreement are concerned; that such coverage for additional insured shall apply as primary insurance, and any other insurance or self-insurance maintained by STUDY AGENCY, its officers, agents, and employees, shall be excess only and not contributing with insurance provided under CONTRACTOR's policies herein. This insurance shall not be cancelled or changed without a minimum of thirty (30) days' advance, written notice given to the STUDY AGENCY.

13.4 In the event CONTRACTOR fails to keep in effect at all times insurance coverage as herein provided, STUDY AGENCY may, in addition to other remedies it may have, suspend or terminate this Agreement upon the occurrence of such event.

13.5 If the CONTRACTOR is a government entity, then it may self-insure such of those risks identified in paragraphs 13.1.1 through 13.1.3 of this Agreement, provided, however, that:

13.5.1 STUDY AGENCY, its officers, agents, and employees, individually and collectively, shall be named as additional insured (except for Workers Compensation Insurance) on CONTRACTOR's self-insurance plan, but only insofar as the operations under this Agreement are concerned;

13.5.2 Such self-insurance plan shall be reasonably satisfactory to STUDY AGENCY; and

13.5.3 All those provisions identified in subparagraph 13.2 of this Agreement concerning the relationship of CONTRACTOR's primary and STUDY AGENCY's excess insurance to each other, the requirement of CONTRACTOR delivering a certificate of insurance or other suitable evidence to STUDY AGENCY, and the cancellation/change of insurance requirements shall apply to such self-insurance plan.

14. AUDITS AND INSPECTIONS

14.1 CONTRACTOR shall at any time during business hours, and as often as STUDY AGENCY may deem necessary, make available to STUDY AGENCY for examination all of its records and data with respect to the matters covered by this Agreement. CONTRACTOR shall, upon request by STUDY AGENCY, permit STUDY AGENCY to audit and inspect all of such records and data necessary to ensure CONTRACTOR's compliance with the terms of this Agreement.

14.2 CONTRACTOR shall maintain books, records, documents, and other evidence pertaining to the reimbursable time and materials and hold them available for audit and inspection by STUDY AGENCY for a minimum of three (3) years from the date this Agreement is completed or otherwise terminated.

15. BUDGET

15.1 CONTRACTOR shall be authorized to rebudget funds up to a maximum of twenty percent (20%) between major categories in the contract budget as contained in Exhibit A. All rebudgeting in excess of twenty percent (20%) requires the prior written approval of the Chief of the Modeling and Meteorology Branch, Planning and Technical Support Division, Air Resources Board, or his representative. Under no circumstances shall the total contract amount exceed *COST*.

16. NOTICES

16.1 The persons and their addresses having authority to give and receive notices under this Agreement include the following:

STUDY AGENCY: John DaMassa, Chief
 Modeling and Meteorology Branch
 Planning & Technical Support Division
 Air Resources Board
 P.O. Box 2815
 Sacramento, CA 95812

CONTRACTOR: *CONTACT PERSON*

ADDRESS

16.2 Any and all notices between STUDY AGENCY and CONTRACTOR provided for or permitted under this Agreement or by law shall be in writing and shall be deemed duly served when personally delivered to one of the parties, or in lieu of such personal services, when deposited in the United States mail, postage prepaid, addressed to such party.

17. DISPUTES

17.1 In the event a dispute between CONTRACTOR and the ARB Program Manager, CONTRACTOR should first discuss the problem informally with the ARB Program Manager. If the dispute is not resolved, the following two-step procedure shall be followed by both parties:

17.1.1 CONTRACTOR and the ARB Program Manager shall each write to the STUDY AGENCY Technical Committee stating the issues in the dispute and the basis for their positions. The STUDY AGENCY Technical Committee shall make a determination within fourteen (14) working days after receipt of the written communications from CONTRACTOR and ARB Program Manager. The STUDY AGENCY Technical Committee shall notify CONTRACTOR and the ARB Program Manager in writing of the decision and the reasons therefor.

17.1.2 If CONTRACTOR or the ARB Program Manager disagrees with the STUDY AGENCY Technical Committee's decision, written notice shall be provided to the other party of an intention to seek non-binding third-party mediation of the dispute. Both parties must agree to submit to mediation. The dispute shall be considered by a panel of three (3) experts in the field of dispute. Each party shall have the right to select one panelist. The selected panel will then select a third member. The panel shall set a hearing date, time, and place convenient to the parties within thirty (30) days of panel selection. Within five (5) working days of the hearing date, each party shall submit a written statement to the panel and the other party setting forth the issues and

arguments to be presented. The hearing shall be informal with an opportunity for both parties to present their arguments. The panel shall provide the parties with a written decision within thirty (30) days of the hearing. The decision shall be binding on the parties, unless referred to the Governing Board within thirty (30) days. The costs of the panel shall be borne equally by the parties.

17.1.3 If either party has so requested, the matter shall be heard by the STUDY AGENCY Board, and the Board's determination shall be final.

18. POLITICAL ACTIVITY PROHIBITED

18.1 None of the funds, materials, property, or services provided under this Agreement shall be used for any political activity, or to further the election or defeat of any candidate for public office contrary to federal or state laws, statutes, regulations, rules or guidelines.

19. LOBBYING PROHIBITED

19.1 None of the funds provided under this Agreement shall be used for publicity, lobbying, or propaganda purposes designed to support or defeat legislation before the Congress of the United States of America or the Legislature of the State of California.

20. CONFLICT OF INTEREST

20.1 No officer, employee, or agent of STUDY AGENCY who exercises any function or responsibility for planning and carrying out the services provided under this Agreement shall have any direct or indirect personal financial interest in this Agreement. CONTRACTOR shall comply with all federal and state conflict of interest laws, statutes, and regulations which shall be applicable to all parties and beneficiaries under this Agreement and any officer, agent, or employee of STUDY AGENCY.

21. COMPLIANCE WITH LAWS

21.1 CONTRACTOR shall comply with all federal and state laws, statutes, regulations, rules, and guidelines which apply to its performance under this Agreement.

22. SEVERABILITY

22.1 In the event that any one or more provisions contained in this Agreement shall for any reason be held to be unenforceable in any respect by a court of competent jurisdiction, such holding shall not affect any other provisions of this Agreement, and the Agreement shall then be construed as if such unenforceable provisions are not a part hereof.

23. TIME IS OF THE ESSENCE

23.1 It is understood that for CONTRACTOR's performance under this Agreement, time is of the essence. The parties reasonably anticipate that CONTRACTOR will, to the reasonable satisfaction of STUDY AGENCY, complete all services to be provided hereunder by *DATE*, provided that CONTRACTOR neither causes nor is caused unreasonable delay in such performance.

24. GOVERNING LAW

24.1 Venue for any action arising out of or relating to this Agreement shall only be in Fresno County, California.

24.2 The rights and obligations of the parties and all interpretation and performance of this Agreement shall be governed in all respects by the laws of the State of California.

25. BINDING UPON SUCCESSORS

25.1 This Agreement, including all covenants and conditions maintained herein, shall be binding upon and inure to the benefit of the parties, including their respective successors-in-interest, assigns, and legal representatives.

26. INSPECTION AND RELEASE OF DATA

26.1 Upon termination or expiration of this Agreement, all data which is received, collected, produced, or developed by CONTRACTOR under this Agreement shall become the exclusive property of STUDY AGENCY, provided, however, CONTRACTOR shall be allowed to retain a copy of any non-confidential data received, collected, produced, or developed by CONTRACTOR under this Agreement, subject to STUDY AGENCY's exclusive ownership rights stated herein. Accordingly, CONTRACTOR shall surrender to STUDY AGENCY all such data which is in its (including its subcontractors, subconsultants, or agents) possession, without any reservation of right or title not otherwise enumerated herein.

26.2 STUDY AGENCY shall have the right, at reasonable times during the term of this Agreement, to inspect and reproduce any data received, collected, produced, or developed by CONTRACTOR under this Agreement. No reports, professional papers, information, inventions, improvements, discoveries, or data obtained, prepared, assembled, or developed by CONTRACTOR, pursuant to this Agreement, shall be released or made available (except to STUDY AGENCY) without prior, express written approval of STUDY AGENCY while this Agreement is in force.

27. NONDISCRIMINATION

27.1 The provisions of Exhibit D, the "Nondiscrimination Clause," is attached hereto and incorporated herein.

28. ENTIRE AGREEMENT

28.1 This Agreement, including all attached exhibits and documents which are referred to and incorporated herein, constitutes the entire agreement between CONTRACTOR and STUDY AGENCY with respect to the subject

matter hereof and supersedes all previous negotiations, proposals, commitments, writings, advertisements, publications, and understandings of any nature whatsoever unless expressly included in this Agreement.

29. WAIVER

29.1 No waiver of any breach of this Agreement shall be held to be a waiver of any other or subsequent breach. All remedies afforded in this Agreement shall be taken and construed as cumulative, that is, in addition to every other remedy provided therein or by law. The failure of STUDY AGENCY to enforce at any time any of the provisions of this Agreement or to require at any time performance by CONTRACTOR of any of the provisions therefor, shall in no way be construed to be a waiver of such provisions nor in any way affect the validity of this Agreement or any part thereof or the right of STUDY AGENCY to thereafter enforce each and every such provision.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day and year first hereinabove written through their respective duly appointed and authorized representatives.

STUDY AGENCY

SAN JOAQUIN VALLEYWIDE AIR
POLLUTION STUDY AGENCY

CONTRACTOR

By _____

By _____

Chair

Print Name and Title

Tax I.D. No.

Recommended for approval:

SAN JOAQUIN VALLEYWIDE AIR
POLLUTION STUDY AGENCY
POLICY COMMITTEE

Approved as to legal form:

SAN JOAQUIN VALLEY UNIFIED AIR
POLLUTION CONTROL STUDY
AGENCY

By _____

By _____

Philip M. Jay

Title _____

Study Agency Counsel

Recommended for approval:

SAN JOAQUIN VALLEYWIDE AIR
POLLUTION STUDY AGENCY
TECHNICAL COMMITTEE

Approved as to accounting form:

SAN JOAQUIN VALLEY UNIFIED AIR
POLLUTION CONTROL STUDY
AGENCY

By _____

By _____

Roger W. McCoy

Title _____

Finance Officer